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The Common Management Information Services and Protocols for the Internet (CMOT and CMIP)

Status of this Memo

This memo defines a network management architecture that uses the International Organization for Standardization's (ISO) Common Management Information Services/Common Management Information Protocol (CMIS/CMIP) in the Internet. This RFC specifies an IAB standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "IAB Official Protocol Standards" for the standardization state and status of this protocol.

Distribution of this memo is unlimited.

Table of Contents

1. Overview 2
2. Introduction 3
3. Protocol Overview 4
3.1. The CMOT Protocol Suite 5
3.2. The CMIP Protocol Suite 6
3.3. Conformance Requirements 6
4. Common Management Information Service Element 7
4.1. Association Policies 7
4.2. CMIS Services 9
4.2.1 General Agreements on Users of CMIS 9
4.2.2 Specific Agreements on Users of CMIS 10
4.3. CMIP Agreements 10
5. Services Required by CMIP 10
6. Acknowledgements 11
7. References 11
8. Security Considerations..... 14
9. Authors' Addresses..... 14

1. Overview

This memo is a revision of RFC 1095 - "The Common Management Information Services and Protocol over TCP/IP" [27]. It defines a network management architecture that uses the International Organization for Standardization's (ISO) Common Management Information Services/Common Management Information Protocol (CMIS/CMIP) in the Internet. This architecture provides a means by which control and monitoring information can be exchanged between a manager and a remote network element. In particular, this memo defines the means for implementing the International Standard (IS) version of CMIS/CMIP on top of both IP-based and OSI-based Internet transport protocols for the purpose of carrying management information defined in the Internet-standard management information base. Together with the relevant ISO standards and the companion RFCs that describe the initial structure of management information and management information base, these documents provide the basis for a comprehensive architecture and system for managing both IP-based and OSI-based internets, and in particular the Internet.

In creating this revision of RFC 1095, the following technical and editorial changes were made:

1) The tutorial section on OSI Management included in RFC 1095 has been removed from this document. After some revisions, the tutorial material may be published as another RFC.

2) The sections in RFC 1095 which discussed the semantics of how to interpret requests in the context of Internet MIBs has been removed from this protocol document. This topic is now discussed in the OIM-MIB-II draft document. This protocol should be useable with MIB-I or MIB-II. But, it will also be able to exploit the new features of the OIM-MIB-II.

3) This document is based on the final International Standards for CMIS/CMIP (ISO 9595/9596) rather than the Draft International Standards.

4) Many of the original agreements defined in RFC 1095 have been accepted and included in the OIW NMSIG implementers agreements. Rather than duplicating these agreements, they have been removed from this memo. This document should be read in conjunction with ISO 9595/9596 (CMIS/CMIP) and the OIW Stable Agreements document.

5) The Association Negotiation describe in RFC 1095 has been changed to align with current international and national agreements. But, it has retained backwards compatibility with

the assignment of an Application Context Name which is identical to the Application Context Name specified in RFC 1095.

2. Introduction

This memo is the output of the OSI Internet Management Working Group of the Internet Engineering Task Force (IETF). As directed by the Internet Activites Board (IAB) in RFC 1052, it addresses the need for a long-term network management system based on ISO CMIS/CMIP. This memo contains a set of protocol agreements for implementing a network management system based on these ISO Management standards. Now that CMIS/CMIP has been voted an International Standard (IS), it has become a stable basis for product development. This profile specifies how to apply CMIP to management of both IP-based and OSI-based Internet networks. Network management using ISO CMIP to manage IP-based networks will be refered to as "CMIP Over TCP/IP" (CMOT). Network management using ISO CMIP to manage OSI-based networks will be refered to as "CMIP". This memo specifies the protocol agreements necessary to implement CMIP and accompanying ISO protocols over OSI, TCP and UDP transport protocols.

This memo must be read in conjunction with ISO and Internet documents defining specific protocol standards. Documents defining the following ISO standards are required for the implementor: Abstract Syntax Notation One (ASN.1) [5, 6], Association Control (ACSE) [7, 8], Remote Operations (ROSE) [9, 10], Common Management Information Services (CMIS) [11] and Common Management Information Protocol (CMIP) [12] with their addenda [32-35]. The specification of a lightweight presentation layer protocol is required for use with the CMOT section of this profile (see RFC 1085 [13]). The SMI (see RFC 1065 [2]), the MIB-I (see RFC 1066 [3]), the MIB-II (see RFC 1156 [28]), and the OIM-MIB-II (see [29]) are used with this management system.

This memo is divided into sections for each of the protocols for which implementors' agreements are needed: CMISE, ACSE, ROSE, and, for CMOT, the lightweight presentation protocol. The protocol profile defined in this memo draws on the technical work of the OSI Network Management Forum [14] and the Network Management Special Interest Group (NMSIG) of the National Institute of Standards and Technology (NIST) (formerly the National Bureau of Standards) [30]. Wherever possible, an attempt has been made to either directly reference or remain consistent with the protocol agreements reached by these groups.

3. Protocol Overview

This part of the document is a specification of the protocols of the OIM architecture. Contained herein are the agreements required to implement interoperable network management systems using these protocols. The protocol suite defined by these implementors' agreements will facilitate communication between equipment of different vendors, suppliers, and networks. This will allow the emergence of powerful multivendor network management based on ISO models and protocols.

The choice of a set of protocol standards together with further agreements needed to implement those standards is commonly referred to as a "profile." The selection policy for this profile is to use existing standards from the international standards community (ISO and CCITT) and the Internet community. Existing ISO standards and draft standards in the area of OSI network management form the basis of this profile. Other ISO application layer standards (ROSE and ACSE) are used to support the ISO management protocol (CMIP). To ensure interoperability, certain choices and restrictions are made here concerning various options and parameters provided by these standards. Internet standards are used to provide the underlying network transport. These agreements provide a precise statement of the implementation choices made for implementing ISO network management standards in IP-based and OSI-based internets.

In addition to the OIM working group, there are at least two other bodies actively engaged in defining profiles for interoperable OSI network management: the OSI Implementors Workshop (OIW) and the OSI Network Management Forum. Both of these groups are similar to the OIM working group in that they are each defining profiles for using ISO standards for network management. Both differ in that they are specifying the use only of underlying ISO protocols, while the OIM working group is concerned with using OSI management in both OSI and TCP/IP networks. In the interest of greater future compatibility, the OIM working group has attempted to make this profile conform as closely as possible to the ongoing work of these two bodies.

This section will describe the CMOT Protocol Suite, the CMIP Protocol Suite and Conformance Requirements common to both CMOT and CMIP. Later sections will specify the implementers agreements for specific layer protocols that comprise the CMOT and CMIP Protocol Suites.

3.1. The CMOT Protocol Suite

The following seven protocols compose the CMOT protocol suite: ISO ACSE, ISO DIS ROSE, ISO CMIP, the lightweight presentation protocol (LPP), UDP, TCP, and IP. The relation of these protocols to each other is briefly summarized in Figure 2.

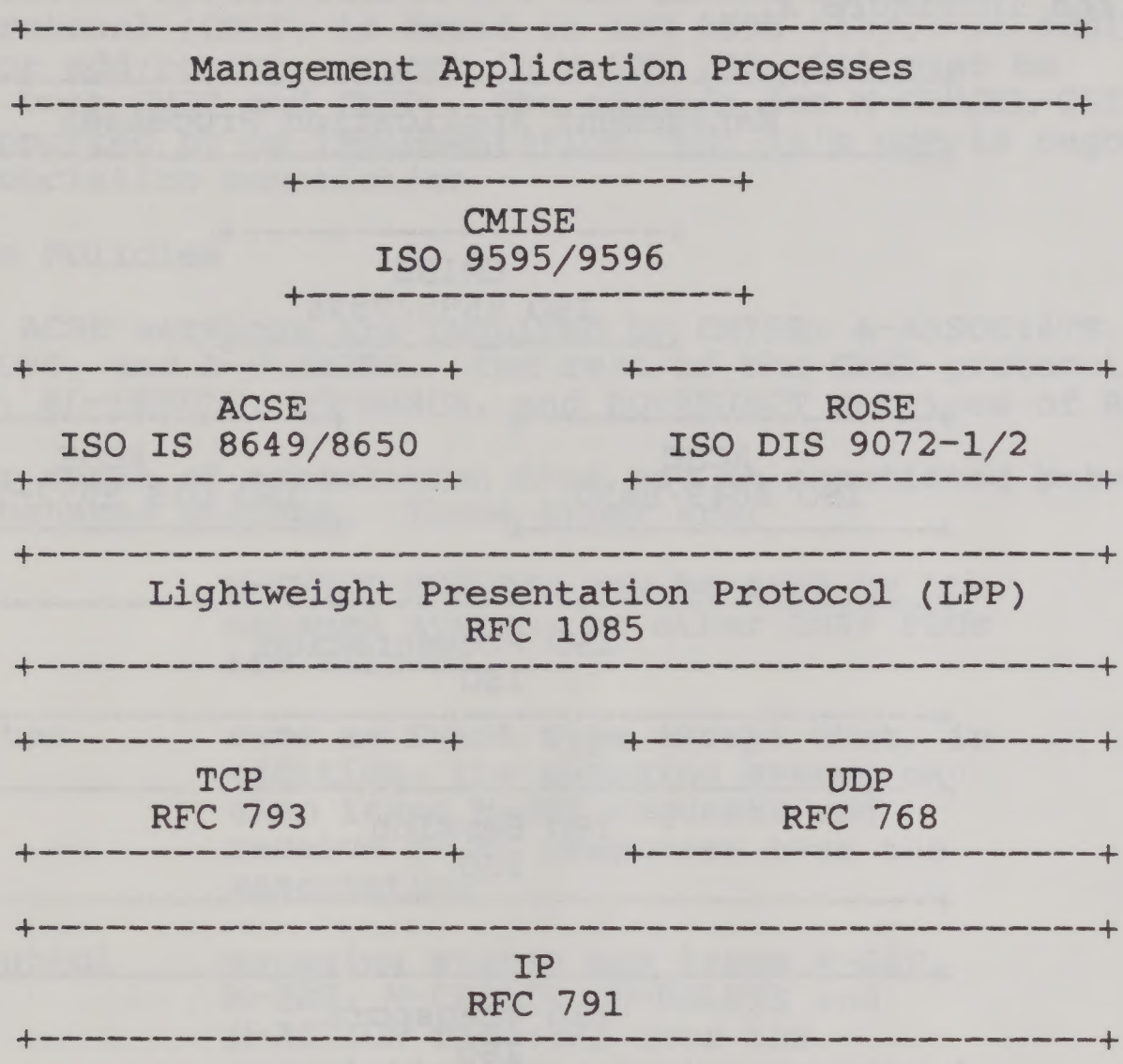

Figure 2. The CMOT Protocol Suite

3.2. The CMIP Protocol Suite

The following six protocols compose the CMIP protocol suite: ISO ACSE, ISO DIS ROSE, ISO CMIP, ISO Presentation, ISO Session and ISO Transport. The relation of these protocols to each other is briefly summarized in Figure 3.

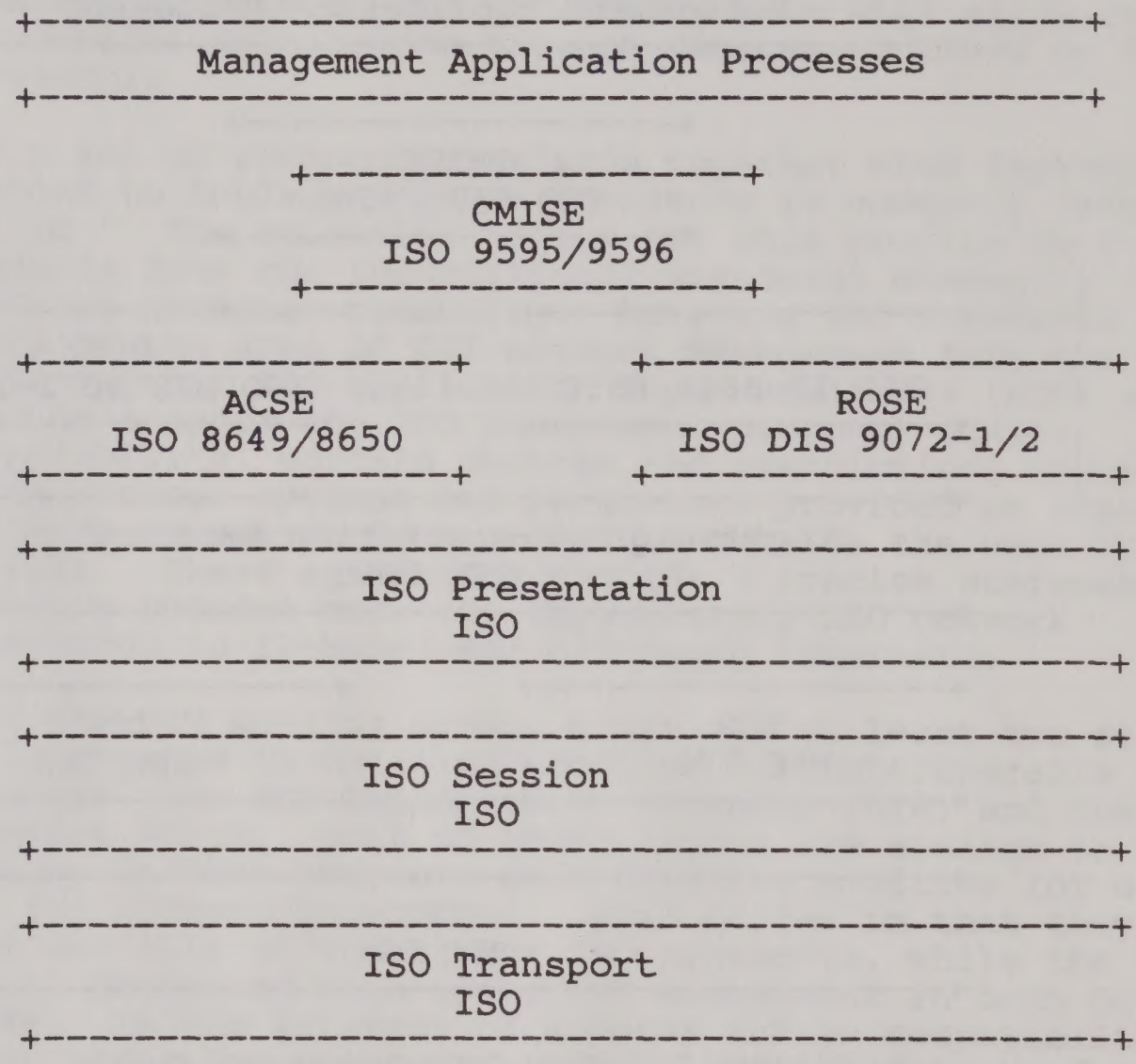

Figure 3. The CMIP Protocol Suite

3.3. Conformance Requirements

A CMOT-conformant system must implement the following protocols: ACSE, ROSE, CMIP, LPP, and IP. A CMOT-conformant system must support the use of the LPP over either UDP or TCP. The use of the LPP over both UDP and TCP on the same system may be supported.

A CMIP-conformant system must implement the following protocols: ACSE, ROSE, CMIP, ISO Presentation, ISO Session and ISO Transport.

4. Common Management Information Service Element

The Common Management Information Service Element (CMISE) is specified in two ISO documents. The service definition for the Common Management Information Service (CMIS) is given in ISO 9595 [11]. The protocol specification for the Common Management Information Protocol (CMIP) is found in ISO 9596 [12]. In addition, the addenda for add/remove support in M-SET [32, 34] must be supported for both CMOT and CMIP. The addenda for M-CANCEL-GET [33, 35] may be supported by an implementation, but it's use is negotiated as part of association negotiation.

4.1. Association Policies

The following ACSE services are required by CMISE: A-ASSOCIATE, A-RELEASE, A-ABORT, and A-P-ABORT. The rest of the CMIP protocol uses the RO-INVOKE, RO-RESULT, RO-ERROR, and RO-REJECT services of ROSE.

There are four types of association that may be negotiated between managing and managed systems. These types are:

Event	M-EVENT-REPORTs may be sent by the managed system; no other CMIP PDUs are allowed
Event/Monitor	same as Event type except that, in addition, the managing system may also issue M-GET requests and receive M-GET responses over the association
Monitor/Control	managing system may issue M-GET, M-SET, M-CREATE, M-DELETE and M-ACTION requests over the association; no event reporting is allowed
Full Mgr/Agent	all functions must be supported

A conformant system must support at least one of these Association types. Note that a system may play both managing and managed system roles, but not on the same association.

The negotiation process uses the A-ASSOCIATE and A-RELEASE services. Application Context Name is used to determine the requestor's "role" in an association (as managing or managed system) and to determine the type of the association.

The following values for Application Context Name are registered for for CMOT and CMIP:

```
{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     cmot1095(1)}
     (for backwards compatible negotiation with RFC 1095 CMOT
     implementations)

{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     manager-event-association(2)}

{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     manager-event-monitor-association(3)}

{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     manager-monitor-control-association(4)}

{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     manager-full-association(5)}

{iso(1) identified-organization(3) dod(6)
     internet(1) mgmt(2) mib(1) oim(9) acn(1)
     agent-event-association(6)}
```

The following negotiation rules are to be used:

1. A managed system may only request an Event association and, in fact, must create an Event association if it has an event to report and no suitable association already exists.

2. Managing systems may request any association type.

3. An association is created by the requesting system issuing an A-ASSOCIATE request with the requestor's AE-TITLE and the desired application context. The responding system then returns either 1) an A-ASSOCIATE response with the requestor's AE-TITLE and the application context which it wishes to accept or 2) an A-ASSOCIATE response rejecting the association.

4. Managed systems may negotiate "downward" from Full to Monitor/Control, Event/Monitor or Event by returning the new application context in the A-ASSOCIATE response to the managing system during the association creation process. In the same fashion, managed systems may negotiate from Event/Monitor to Event.

5. When a managing system receives an application context in an A-ASSOCIATE response that differs from the context sent in an A-ASSOCIATE request it may either proceed with the new context or refuse the new context by issuing an A-RELEASE request.

A-RELEASE is used when the requestor does not agree with the new context. A-ABORT is used for invalid negotiation. If A-ABORT were to be used to terminate an association, there exists the potential for loss of information, such as pending events or confirmations. A-ABORT must be used, however, when a protocol violation occurs or where an association is not yet established.

4.2. CMIS Services

4.2.1 General Agreements on Users of CMIS

The general agreements on users of CMIS shall be as specified in the OIW Stable Agreements [30] section 18.6.2.

The following additional agreements are specified.

- A system need only implement the services and service primitives required for the association types (section 4.1) that it supports.

- Current/Event times shall be fields shall use 1 millisecond granularity. If the system generating the PDU does not have the current time, yet does have the time since last boot, then GeneralizedTime can be used to encode this information. The time since last boot will be added to the base time "0001 Jan 1 00:00:00.00" using the Gregorian calendar algorithm. (In the Gregorian calendar, all years have 365 days except those divisible by 4 and not by 400, which have 366.) The use of the year 1 as the base year will prevent any confusion with current time.

  If no meaningful time is available, then the year 0 shall be used in GeneralizedTime to indicate this fact.

4.2.2 Specific Agreements on Users of CMIS

The specific agreements on users of CMIS shall be as specified in the OIW Stable Agreements [30] section 18.6.3.

The following additional agreements are specified:

- Event time shall be mandatory for all events.

- Both the "managed Object Class" and "managed Object Instance" parameters must be present in the following CMIS Service Response/Confirmation primitives: the M-EVENT-REPORT Confirmed, the M-GET, the M-SET, the M-ACTION, the M-CREATE, and the M-DELETE.

4.3. CMIP Agreements

The CMIS and CMIP implementers agreements documented in the OIW Stable Implementers Agreements [30] plus those mandated by the CMIP standard will be used for both CMOT and CMIP. In addition to these implementers agreements, the following specific agreements must be observed:

- An implementation is required to support all filter items except subsetOf, supersetOf, nonNullSetIntersection, and substrings.

- The "managedObjectInstance" field must be present in the ProcessingFailure Error PDU. The "managedObjectClass" field must be present in the NoSuchArgument Error PDU.

[Temporary Note: The CMIS/P implementers agreements have reach a fairly stable status in the OIW working agreements document. It is expected that the CMIS/P agreements (18.6.2 and 18.6.3) will be recommended to be moved into the stable agreements document during either the June 1990 meetings. Reference [30] points to the presumed June 1990 updated version of the stable agreements document.]

5. Services Required by CMIP

The services required by CMIP shall be as specified in the OIW Stable Implementors Agreements [30] section 18.6.5.

The following additional agreements are specified:

- ASCE Requirements: Application contexts shall be as defined in section 4.1 of these agreements. The values and defaults

of parameters to the ACSE parameters given to the presentation service are specified in RFC 1085 [13] for CMOT and in the NIST Stable Implementers Agreements [30] for CMIP.

- o Presentation Requirements: CMOT implementations shall be supported by the Lightweight Presentation Protocol (LPP) [13]. The LPP may use either TCP or UDP. When UDP is used, an implementation need not accept LPP PDUs whose length exceeds 484 octets.

- o Session Requirements: CMOT implementations will not require the session protocol.

6. Acknowledgements

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8. Security Considerations

Security issues are not discussed in this memo.

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